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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--|-------------|----------------------|-------------------------------|------------------|
| 09/409,644 | 10/01/1999 | NATHAN S. LEWIS | 00016-022001/CIT 2883 | 5684 |
| 26138 | 7590 | 05/26/2010 | | |
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| | | | ART UNIT | PAPER NUMBER |
| | | | 1797 | |
| | | | MAIL DATE | DELIVERY MODE |
| | | | 05/26/2010 PAPER | |

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

09/409,644

Applicant(s)

LEWIS ET AL.

Examiner

Arlen Soderquist

Art Unit

1797

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 April 2010.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 50-72, 85-90, 98-110, 112-123 and 126-159 is/are pending in the application.
- 4a) Of the above claim(s) 50-72 and 85-90 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 98-110, 112-123 and 126-159 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date: _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 98-110, 112-123 and 126-159 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement and lack of enablement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Each of the independent claims now contain the language "wherein the regions of similar material are separated by about 10-1000 angstroms". In these claims there are two different regions claimed – a doped or undoped conductive organic material and a conductive material compositionally different than the conductive organic material. There are clarity issues as noted below regarding this claim language. However, there are three possibilities for the scope of this language: that either the doped or undoped conductive organic material or the conductive material compositionally different than the conductive organic material are separated from other regions of similar material by the required distance or both materials are separated from other regions of similar material by the required distance. As noted in the decision by the Board of Appeals, the disclosure/written description does not support making the structure of the alternating/interpenetrating regions with at least both of the regions being separated for similar regions by the required distance and there does not appear to be basis for the regions of conductive organic material being separated for other regions of similar material by the required distance.

3. Claims 98-110, 112-123 and 126-159 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Each of the independent claims now contain the language "wherein the regions of similar material are separated by about 10-1000 angstroms". In these claims there are two different regions claimed – a doped or undoped conductive organic material and a conductive material compositionally different than the conductive organic material. Examiner cannot find antecedent basis for "the regions of similar material" of the

language of the claims in the two types of conductive materials that are claimed. Based on the enablement/written description problems noted above and the antecedent basis problems noted here, examiner will treat the claims as the regions of compositionally different conductive material are separated by the required distance.

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 98 104-105, 108-110, 112, 115, 117, 120-122, 126-127 and 159 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Haugen (Analytical Chemistry 1988, newly cited and applied). In the paper Haugen presents an interdisciplinary approach to microinstrumentation. Relevant to the instant claims is the section on chemiresistors beginning on page 27A. In that section it is taught that very thin layers of semiconductor materials exhibit substantial changes in electrical resistance when even fractional monolayers of materials having a permanent or an induced dipole moment are deposited on them. Not surprisingly, individual thin-film materials show different levels of response, not only from changes in the amount of vapor absorbed or adsorbed on them, but also because of variations in sensitivity to the effect. Such devices offer attractive alternatives as microsensors. Organic semiconductive layers are particularly suitable here; they can be made in extremely thin layers, they have a high intrinsic response to adsorbed material, and they have no tendency to form surface protective layers during exposure to air. They can also be deposited easily in films of controllable thickness. Such a chemiresistor is extremely sensitive and can be used to detect less than a monolayer of adsorbed material. Current detection limits, even before complete optimization, are on the order of picograms. The selectivity of a chemiresistor depends on the characteristics of the thin-film material on which the target material deposits. Unfortunately, semiconductors that exhibit the strongest chemiresistance effect have extremely high resistivities. This fact, coupled with the very thin layers that are employed, yields a film of extremely high resistance. Therefore fairly high operating voltages are required to produce easily measured currents. Such high voltages can cause electrical breakdown and, even at lower levels, electrochemical decomposition.

Obviously it would be desirable to reduce the length of the chemiresistive layer and employ electrodes that have a relatively large area so that currents can be as large as possible for a given driving voltage. Unfortunately, calculations show that the optimal length of the resulting chemiresistor is on the order of only a few hundred angstroms -- well below that obtainable with integrated-circuit technology of that time. A new procedure has recently been developed to overcome this limitation. In this technique, a very thin (less than 300 Å) strip of gold is deposited on quartz between thicker contact strips of the same material. After these films have been vacuum-deposited, the layer is heated to approximately 120 °C, the temperature at which the films recrystallize into arrays of gold microcrystallites separated by some tens of angstroms. This arrangement is shown schematically in figure 5 of the paper. In such a discontinuous thin layer, current can travel between the electrodes by quantum tunneling across the narrow gaps between gold crystallites. Currents up to 1 µA have been demonstrated by using 1-2 V across the electrodes -- a voltage low enough to avoid instability and short device lifetimes. When the thin film (a few monolayers at most) of semiconductor (phthalocyanine) is deposited on top of the gold "layer," a sensitive and stable detector is produced. In a manner similar to other sensors, the thin-film semiconductor sensor is made selective through the use of arrays of devices. Such an array can be constructed by microfabrications simply on a single sheet of quartz substrate material. The array of electrodes on the quartz substrate is then separated by thin strips of recrystallized gold and coated with different semiconductor (phthalocyanines) layers. Again, a pattern of responses is produced that is independent of sample concentration but that indicates the identity of a particular sample constituent (see figure 6 of the paper). Working curves showing the simultaneous detection of ammonia and water on an electron-tunneling gas sensor are shown in figure 6. Figure 6(b) demonstrates selectivity by show the response to test vapors of water, ammonia and ethyl alcohol for an array of six quantum-tunneling chemiresistors, each having a different phthalocyanine.

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
 2. Ascertaining the differences between the prior art and the claims at issue.
 3. Resolving the level of ordinary skill in the pertinent art.
 4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
7. Claims 99, 101, 106-107, 113, 128-135, 137, 139 and 142-158 are rejected under 35 U.S.C. 103(a) as being unpatentable over Haugen as applied to claims 98 104-105, 108-110, 112, 115, 117, 120-122, 126-127 and 159 above, and further in view of Gibson (WO 96/07901) or Lewis (US 5,571,401). Haugen does not teach other types of conductive organic materials or means to identify the substances based on the signal from the different sensors.

In the patent application Gibson teaches an odor sensor. Page 1 teaches that sensors are important for a variety of applications including food freshness, headspace analysis and detection and quantification of bacteria (micro-organisms). The page also teaches that the a personnel recognition sensor described includes a multiplicity of differentially responding chemo-resistor elements (a plurality or an array of sensors); a detector responsive to signals provided by the multiplicity of elements and arranged to provide an output signal characteristic of the multiplicity of signals; and a housing with the elements disposed therein having an inlet arranged so that a gaseous sample passing into or through the inlet contacts all of the elements in use (see each of the independent claims). Each element has a non-conductive substrate, a plurality of electrodes disposed on the substrate and one or more layers of a conductive polymer overlaying the electrodes, with the conductive polymers of at least two of the elements being different. The page also teaches that the sensors have been prepared on interdigitated gold electrodes (page 5) by polymerizing a number of monomers using chemical or electrochemical techniques; the polymers produced are electrically conducting and have varying sensitivities to volatile odor compounds; and the interaction between an odor compound and a conducting polymer is detected by a change in the electronic characteristics particularly the **resistance, impedance, reactance or capacitance** (instant claims 115,134,137,157) of the polymer film, which may be indirectly measured using changes in the applied potential or current. Page 2 teaches that the

sensor may also include a memory (instant claim 150) adapted to store a library of odor profiles characteristic of particular individuals and means for comparison of the odor profile constituted by the multiplicity of signals from the sensor elements with an odor profile contained in said library. Standard pattern recognition techniques or a neural network (instant claims 147,149,152-153) may be adapted to retain characteristic features of the multiplicity of signals for incorporation into the library. The paragraph bridging pages 2-3 teaches that the conductive polymers may be selected from the following group: perimidine, polybenzene, polyphenylenesulphide, polyacetylene, **polyaniline**, polyphenylenediamine, **polypyrrole**, **polythiophene**, polyindole, polyimidazole, polythiazole, polybithiophene, **polyphthalocyanine**, polytryptophan and copolymers thereof. The following paragraph on page 3 teaches that a wide range of dopants may be employed including: nitrate, perchlorate, chloride, bromide, fluoride, sulphate, dodecyl and other alkyl sulphates, sulphonate, alkyl sulphonate, aryl sulphonate, fluoroborate, borate, phosphate, carbonate, iodide, ferricyanide; ferrocyanide, alkyl carboxylic acids (octanoic acid, acetic acid, etc), chromate, thiosulphate, sulphite, silicates and vanadate. Page 6 teaches that chemical polymerization may be carried out using suitable oxidizing agents such as sodium persulphate, sodium periodate, ferric nitrate, ferric perchlorate and the like added to a solution of the monomer deposited onto the upper surface of the cleared transducer. The polymeric material is formed as an insoluble layer and the upper surface of the interdigitated area covers the whole active surface of the transducer. Page 6 also teaches that electrochemical polymerization may be achieved by incorporating the interdigitated transducer into an electrochemical circuit as the anode or cathode dependent on the polymer species to be formed. Anodic deposition, the most common technique, is carried out by immersion of the transducer in a monomer solution with a platinum counter-electrode adjacent the surface and a reference electrode (silver/silver chloride or calomel) connected into the circuit via a salt bridge. The system may then be either maintained at constant potential or alternatively the potential may be cycled between two predetermined values to allow formation of the polymer film on the transducer surface. Examples on pages 11-13 illustrate the electrochemical polymerization process for poly-1,4-phenylenediamine, polyimidazole, polyquinoline, poly-N-phenyl-1,4-phenylenediamine, and a co-polymer of pyrrole and 1-methylpyrrole. The first full paragraph of page 13 teaches that polymers prepared using similar techniques include: **polypyrroles**,

polythiophenes, polyindoles, **polyphthalocyanines**, **polyanilines**, polycarbazoles, polythionine, polyaminonaphthalenes, polyaminoanthracenes, polyphenylenediamines, polyaminiophenols, polynaphthyl(ethylenediamine), polyimidazoles, polyquinolines, polytryptophan, polyhetero cycles, polyaminohetero cycles and substituted derivatives of the above compounds. The same paragraph also teaches that **copolymers and blends of the above compounds may be employed**. The listed polymers may be treated with various ionic dopant molecules, as outlined above, incorporated into the conducting films during and post polymerization. The last full paragraph of page 13 teaches that the array includes between 3 to several hundred sensors. Multiple arrays may incorporate 16 and 32 sensors and may be arranged to operate from either a constant current or constant voltage power supply. The sensor array may be disposed in the housing adapted to allow flow of a gaseous sample over each of the sensor elements. A gaseous sample may be simply injected into the space above the array. Alternatively a piston, bellows or other pump arrangement may be employed. Figure 1 and its description on pages 14-15 present the response of a 16 sensor array to two samples of odor from a subject collected in a syringe and blown across the array. The sensor elements that make up the array include the following polymers and dopants: 1) poly-n-ethylaniline with SO₄ counter ion; 2-3) poly-aniline with SO₄ counter ion; 4-5) poly-tryptophan with SO₄ counter ion; 6) poly-2-methoxy-5-nitroaniline with SO₄ counter ion; 7) thiophene/thiophene-3- carboxylic acid copolymer with tetrabutyl-ammonium perchlorate counter ion; 8) poly-aniline with ethanol and with SO₄ counter ion; 9) poly-pyrrole with octanoic acid ethyl ester dopant; 10) poly-pyrrole with an upper layer of poly-tryptophan with octanoic acid ethyl ester dopant and with ClO₄ counter ion; 11-12) poly-1,4-phenylenediamine with Cl counter ion; 13) poly-pyrrole with Cl counter ion; 14) poly-pyrrole with tetrabutyl-ammonium perchlorate counter ion; 15) pyrrole/1-methyl pyrrole copolymer with NO₃ counter ion; and 16) polypyrrole with octanoic acid ethyl ester dopant. Figures 3-4 show alternative configurations of the interdigitated electrodes. Pages 3-4 describe a second array of sensors including a different set of polymers that is intended for food analysis and quality control identification of bacterial infection, prediction of oestrus in livestock and environmental monitoring (instant claim 148). Page 16 describes a system for measuring the response of a 16 sensor array to compounds using a setup to sample the headspace above a liquid sample. This system uses a personal computer and dedicated software to acquire and process the

resistance data. Figures 5-8 show various responses to the 21 compounds listed on page 17 for some of the polymer conductors that are discussed. Gibson does not elaborate on what constitutes a blend of the polymer compounds listed on page 13 and how the blend is different from the copolymers listed in the same sentence.

In the patent Lewis teaches sensor arrays for detecting analytes in fluids. Chemical sensors for detecting analytes in fluids comprise first and second conductive elements (e.g. electrical leads) electrically coupled to and separated by a chemically sensitive resistor which provides an electrical path between the conductive elements. The resistor comprises a plurality of alternating nonconductive regions (comprising a nonconductive organic polymer) and conductive regions (comprising a conductive material) transverse to the electrical path. The resistor provides a difference in resistance between the conductive elements when contacted with a fluid comprising a chemical analyte at a first concentration, than when contacted with a fluid comprising the chemical analyte at a second different concentration. Arrays of such sensors are constructed with at least two sensors having different chemically sensitive resistors providing dissimilar such differences in resistance. Variability in chemical sensitivity from sensor to sensor is provided by qualitatively or quantitatively varying the composition of the conductive and/or nonconductive regions. An electronic nose for detecting an analyte in a fluid may be constructed by using such arrays in conjunction with an electrical measuring device electrically connected to the conductive elements of each sensor. Figure 1 shows an overview of sensor design and an overview of sensor and system operation. It is noted that the array is of a plurality of polypyrrole-based sensors. Figures 4-7 show sensor responses and pattern recognition based analysis of the responses to different vapors. Table 1 lists the various conductive materials including conducting polymers (poly(anilines), poly(thiophenes), poly(pyrroles), poly(acetylenes), etc.), carbonaceous materials (carbon blacks, graphite, coke, etc.), inorganic metals and metal alloys (Ag, Au, Cu, Pt, AuCu alloy, etc.), highly doped semiconductors, conductive metal oxides and superconductors.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate/substitute known polymer conductive materials as taught by Gibson or Lewis into the sensor/sensor array of Haugen and to use polymer sensors and the standard pattern recognition techniques or a neural network as taught by Gibson or Lewis because of the

known ability to sense different vapors as shown by Gibson or Lewis in a system similar to that described by Haugen. Selection of specific polymers would have been a results effective variable dependent upon the analyte of choice and would have started with the specifically exemplified polymers of Gibson or Lewis.

8. Claims 100, 102-103, 113, 117-121, 123, 135 and 139-143 are rejected under 35 U.S.C. 103(a) as being unpatentable over Haugen or Haugen in view of Gibson or Lewis as applied to claims 98-99, 101, 104-110, 112-113, 115, 117, 120-122, 126-135, 137, 139 and 142-159 above, and further in view of Stetter (US 5,512,882) or Wampler. Haugen does not teach other conductors besides gold in the sensing area.

In the patent Stetter teaches a chemical sensing apparatus for the detection of a vapor of a selected chemical substance includes a sensor whose impedance changes upon exposure to such a vapor. The sensor comprises a polymer whose physical structure is altered by the vapor, e.g., through expansion or disintegration, and electrically conductive elements that are interspersed with or separated by the polymer. The interspersed elements may consist of a fine powder of carbon or of a metal in a matrix of silicone or other vapor-sensitive polymer. The electrical contacts between the powder particles are weakened when the polymer swells or disintegrates, which results in increased resistance. Alternatively, the capacitance between two conductive layers separated by a polymer layer decreases, and hence the impedance increases, when the polymer swells upon exposure to the vapor. In the paragraph bridging columns 2-3, Stetter teaches that the particles are conductive and include carbon powder (carbon black), copper, silver, gold, platinum or other suitable metal. The patent discusses how the conductivity can be affected by either the polymer swelling or being degraded due to the interaction of the analyte with the polymer.

In the paper Wampler discusses the chemical synthesis and characterization of composites of polypyrrole and carbon black. A new class of molecular composites of carbon black and an electronically conducting polypyrrole has been synthesized by chemically polymerizing pyrrole in an aqueous dispersion of carbon black. The carbon black content of these composites can be varied from ~5% to ~85% (by weight). The surface areas and densities of these composites were compared to corresponding mixtures of carbon black and polypyrrole. The influence of carbon black on the efficiency of polymerization of pyrrole is described. The

effect of carbon black content on the electronic conductivity of the composite has been mapped, and compared with the corresponding behavior of a mixture of carbon black and poly(vinyl chloride). The influence of the parent black characteristics (porosity, void vol., surface area) on the electronic conductivity of the resultant composite has been probed by comparing the behavior of composites derived from six commercial and experimental blacks. The temperature dependence of the composites has been studied as a function of the carbon black content. The application of these new materials is examined. The first page of the paper teaches that these potential application include sensors, electrocatalysis, super capacitors and fuel cells. In the sentence bridging pages 1811-1812 Wampler teaches that other similar composites of conducting polymers with polymers, metals, or metal oxides has extended the scope of their use. The paper clearly shows that the composite is superior to either component of the composite when applied to the electrocatalysis of chromium(VI) to chromium(III).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the various conduction materials taught by Lewis, Stetter or Wampler into the sensing composition of Haugen because of their known ability to modify the conductivity/ resistivity of a material as taught by Lewis, Stetter or Wampler. One of ordinary skill in the art would have recognized that the methods used by Lewis, Stetter or Wampler would have produced a sensing layer that included the particles or regions of conductor in the sensing composition in a manner substantially similar to that of Haugen, thus providing the benefits relative to conductivity as taught by Haugen.

9. Claims 114, 116, 136, 138 and 158 are rejected under 35 U.S.C. 103(a) as being unpatentable over Haugen or Haugen in view of Gibson or Lewis as applied to claims 108, 113, 128, 135, 137 and 158 above, and further in view of Mifsud (both US 5,801,297 and WO 95/08113). Haugen does not teach temperature control or arrays including other sensor types other than conductive organic sensing materials.

In the patent and patent application Mifsud teaches methods and devices for the detection of odorous substances and applications. A device for carrying out a method of odor detection including, in particular, a plurality of chambers, each having a plurality of semi-conductor gas sensors, conductive polymer gas sensors, surface acoustic wave gas sensors, as detection means, a variable flow gas pump for forming a gas flow in said chambers, measurement electronic

device for operating the detection means, a data processing unit for recording in a file the olfactory prints obtained using the detection means, and for comparing the detected impressions with those in the file so that odors may be identified and recognized. Applications, especially to drugs, explosives, body odors and food seals are described. The sensitivity to temperature and humidity of semiconductive (metal oxide: Mifsud, col. 7, 11. 47-49) gas sensors 6, conductive polymer gas sensors 7, and surface acoustic wave gas sensors 8 (Mifsud, col. 5, 11.44-46) are sensitive to the temperature and humidity (id. at col. 6, 1.65 to col. 7, 1. 1) is also taught.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate other types of sensors such as the metal oxide and/or surface acoustic wave devices taught by Mifsud into the Haugen device because of the ability to use them in combination to discriminate odors that would not easily be discriminated by a single type of sensor as taught by Mifsud.

10. Claims 98-99, 101, 104-110, 112-113, 115, 117, 120-122, 126-135, 137, 139 and 142-159 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gibson as described above in view of Haugen as described above and Barisci (Trends in Polymer Science, 1996). Gibson does not teach the incorporation of a compositionally different conductor into the conducting polymer sensing devices.

In the paper Barisci gives a review of conducting polymer sensors. The review examines recent advances in the application of electrically conducting polymers in sensing devices. Figures 1-2 and 4, reproduced below, show some representative conducting polymers and setups for different measurement methods found in the references applied against the claims. In 2(b) the working electrode is separated from the other two electrodes by the polymer layer so that in all instances the potential, current or resistance being measured is measured through the conducting polymer layer. The second paragraph of the article on page 307 teaches that the discovery of conductive electroactive polymers shown in figure 1 heralded a new era in electrochemical research because the materials are inherently conducting, an unusual property for a polymer. In the course of numerous studies it has become obvious that the electrical properties of these new materials are very dependent on their chemical composition and on the chemical environment to which they are exposed. This susceptibility to the chemical environment provides the basis for the use of these materials in new sensing technologies.

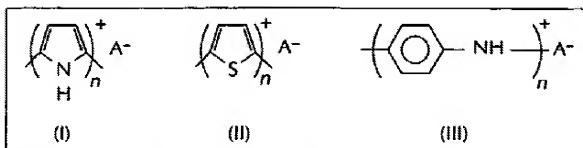


Fig. 1 Idealized structures of some common conducting electroactive polymers: polypyrroles (I), polythiophenes (II) and polyanilines (III) (A^- , counterion).

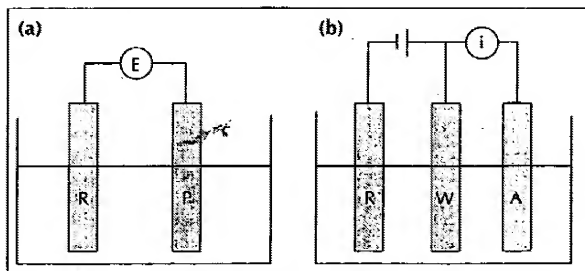


Fig. 2 (a) Setup for potentiometric measurement techniques: E, potential-measuring device; R, reference electrode; and P, polymer electrode. (b) Setup for current-measuring techniques: i, current-measuring device; A, auxiliary electrode; W, working electrode; and R, reference electrode.

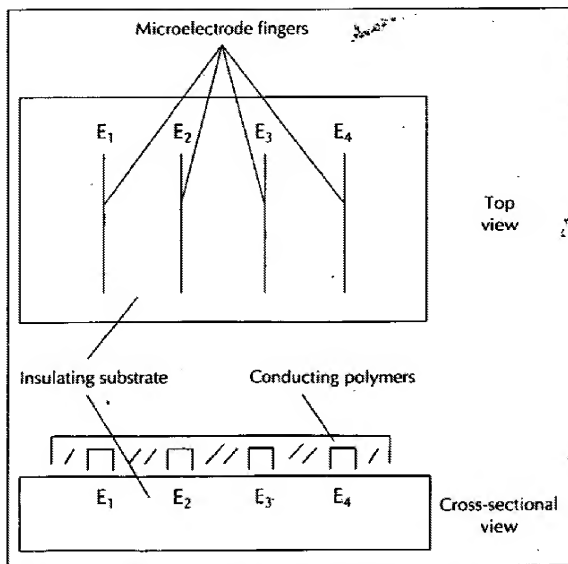


Fig. 4 Microelectrode array for resistance measurements. Current is passed between E_1 and E_4 , and the voltage drop between E_2 and E_3 is measured. This voltage is used to calculate the resistance.

Methods of signal generation, mainly electrical and electrochemical, are discussed, as are strategies for introducing into the polymer structure appropriate analyte recognition characteristics. The use of conducting polymers in gas sensors and in solution sensors for detection of chemical and biochemical species was reviewed with some conclusions. Relative to the methods of signal generation, page 307 teaches that the polymers can produce signal through

potentiometric, current-measuring and conductometric/resistometric methods (see figures 2 and 4 above). The current-measuring methods (pages 307-308) are taught as including 3 or 4 ways that an analyte can interact with the conductive polymer (e.g. polypyrroles, polythiophenes and polyanilines) to modify the current flow as a function of the applied potential. Particularly relevant to the instant invention is the fact that the current measuring section on page 307 points to the conductometric/resistometric section (page 308) for one way that the current flow can be modified through interaction of an analyte and the conducting polymer. Further it is clear from the discussion of both sections that the current flow can be affected by the interaction of the analyte with the polymer or its counter ion (see the second full paragraph of the right column of page 308 and in particular the last sentence of the paragraph). Thus there is a connection between the different signal generation methods and the interaction of the analyte with the polymer that would have been recognized by one of skill in the art. In other words one of ordinary skill in the art would have recognized that changes affecting the current flow would have been expected to provide a measurable signal in both the current measuring and conductometric/resistometric methods. In the solution sensor section, amperometric detection is discussed. Relevant to the instant claims is the second full paragraph of that section on page 308. This paragraph teaches that amperometric detection is based on the changes in current flow caused by oxidation/reduction of the polymer. This paragraph also teaches that the selectivity to a particular anion or anions is influenced by counter anion incorporated into the polymer. The response observed is due to the inclusion/expulsion of cations present in solution as the polymer is reduced or oxidized. The first full paragraph of page 309 discusses the use of overoxidized polypyrrole, known to be less conductive (more resistive), as analytical sensor with sufficient signal to function as a sensor. This section also points to changes in a current measuring setup (amperometric) causing changes that would have been recognized as being measurable by the conductometric/resistometric methods. In the gas sensor section of the paper both electronic interactions with the polymer and swelling of the polymer by the analyte are discussed as the basis for the measurable changes in the current flow in the polymers. In the second full paragraph of the gas sensor section on page 310, the gas sensing properties of polypyrrole are discussed with the sensitivity of the polymer to different gases (NO_2 and H_2S) being based on their oxidizing or reducing the polymer. **The signal results from the associated change in the**

resistance of the polymer. This clearly shows a connection between the oxidation/reduction (redox) state of the polymers and the resistance level of the polymer and a corresponding expectation that changes causing signals with for a measurement method of the current measuring type **also causing a measurable change in the resistance of the polymer!** Page 310 also discusses the use of different pattern recognition methods when arrays of the sensors are used (see right column). In the first paragraph of page 311, a discussion of composite materials in which the conducting polymer is combined with another material. These composite materials showed improved reproducibility when used as sensors, adequately compensating for any problems due to an expected lower sensitivity. The third and fourth paragraphs of the same page discuss the versatility of these conducting polymers and the fact that the molecular structure of these materials influences their electrical properties and enables their interaction with a wide variety of chemical species leading to useful applications in solution and vapor phase sensing.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate a discontinuous conductor such as the microcrystalite gold material as taught by Haugen between the electrodes of Gibson because of the ability to reduce the resistivity of the organic conductor materials as taught by Haugen to enable the detection to occur under more reasonable conditions as taught by Haugen and the recognized ability of conductive polymers to be affected by interactions in a number of sensing formats in a manner that changes the electronic structure and as a result the resistivity of the polymer as shown by Barisci. Selection of specific polymers would have been a results effective variable dependent upon the analyte of choice and would have started with the specifically exemplified polymers of Gibson or Barisci.

11. Claims 100, 102-103, 113, 117-121, 123, 135 and 139-143 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gibson in view of Haugen and Barisci as applied to claims 98-99, 101, 104-110, 112-113, 115, 117, 120-122, 126-135, 137, 139 and 142-159 above, and further in view of Lewis, Stetter (US 5,512,882) or Wampler (all as described above). Gibson does not teach other conductors in the sensing area.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the various conduction materials taught by Lewis, Stetter or Wampler into the sensing composition of Gibson because of their known ability to modify the

conductivity/ resistivity of a material as taught by Lewis, Stetter or Wampler. One of ordinary skill in the art would have recognized that the methods used by Lewis, Stetter or Wampler would have produced a sensing layer that included the particles or regions of conductor in the sensing composition in a manner substantially similar to that of Haugen, thus providing the benefits relative to conductivity as taught by Haugen.

12. Claims 114, 116, 136, 138 and 158 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gibson in view of Haugen and Barisci as applied to claims 108, 113, 128, 135, 137 and 158 above, and further in view of Mifsud as described above. Gibson does not teach temperature control or arrays including other sensor types other than conductive organic sensing materials.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate other types of sensors such as the metal oxide and/or surface acoustic wave devices taught by Mifsud into the Gibson device because of the ability to use them in combination to discriminate odors that would not easily be discriminated by a single type of sensor as taught by Mifsud or in the review of Barisci.

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The additionally cited art relates to gas sensor structures, the presence of metal particles in conductive organic materials and an array of sensors including organic polymer sensors in combination with other types of gas sensors.

14. Applicant's arguments with respect to the claims have been considered but are moot in view of the new ground(s) of rejection. The Haugen reference clearly teaches an anticipatory structure in which a discontinuous gold layer/array of gold microcrystallites having the required spacing forms one set of conductor regions and an organic conductor forms a second set of regions in the sensing material.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Arlen Soderquist whose telephone number is (571)272-1265. The examiner can normally be reached on Monday-Thursday and Alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vickie Kim can be reached on (571) 272-0579. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 1797

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/Arlen Soderquist/

Primary Examiner, Art Unit 1797